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AUTHOR Franke, Richard H.; Paduch, Pamela J.
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ABSTRACT

Since the time of Galton, high correlations have been noted in the IQ levels of identical twins, with relationships for twins reared in different families being only slightly lower than for twins reared together. This evidence has been held to demonstrate that intellectual differences among individuals and among groups are largely determined by genetics, and to suggest the futility of educational programs to remedy environmental deficiences. In the present study, an alternate procedure is used that avoids the participation of common environmental factors in the apparent genetic correlation of IQ levels. This procedure involves relating differences in IQ between separated identical twins to differences in the environments experienced. By stepwise multiple regression, 78 percent of the variance in inter-twin IQ difference is explained by differences in educational, physical, and family environment. Reanalysis of a "classical" set of data from separated identical twins indicates specific environmental factors that can be substantial determinants of intellectual development, even given the relatively benign conditions generally experienced in the United States. (Author/RM)

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Environmental Sources of Intelligence Differences Among Separated Identical Twins

Richard H. Franke, Loyola College in Maryland

Pamela J. Paduch, Worcester Polytechnic Institute

Abstract

Since the time of Galton, high correlations have been noted between the IQ levels of identical twins, with relationships for twins reared in different families only slightly lower than for twins reared together. This evidence has been held to demonstrate that intellectual differences among individuals and among groups are largely determined by genetic differences, and to suggest the futility of educational programs directed to the remedy of environmental deficiencies. In the present study, an alternate procedure is used, which avoids the participation of common environmental factors in the apparent genetic correlations of IQ levels, by instead relating differences in IQ between separated identical twins to differences in environment experienced. By stepwise multiple regression, 78% of the variance in inter-twin IQ difference is explained by differences in educational, physical, and family environment. Reanalysis of a "classical" set of data from separated identical twins indicates specific environmental factors which can be substantial determinants of intellectual development, even given the relatively benign conditions generally experienced in the United States.

Paper to be presented, 1984 Annual Convention of the American Psychological Association, Toronto, Canada.

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Environmental Sources of Intelligence Differences Among Separated Identical Twins

Richard H. Franke, Loyola College in Maryland

Pamela J. Paduch, Worcester Polytechnic Institute

In his still much discussed 1969 Harvard Educational Review article, Arthur Jensen appraised correlations of intelligence quotient levels for identical twins who had been reared together and for twins reared in different families. The high inter-twin IQ correlations obtained even for adults who had been separated as infants provided "the conceptually simplest estimate of hereditability" at about 75%--a figure which was supported by several alternative data sets and evaluation procedures (p. 51; pp. 50, 52-54). Since only about 25% of the variance in intelligence remained to be explained by environmental differences in the United States, those educational and other programs which attempt to boost higher IQ through the improvement of environmental conditions can have only very limited achievements.

The present study follows others, including Jensen, in suggesting that environmental factors such as nutrition, social stimulation, and education can influence intellectual development. However it suggests that the opportunities for improvement may be greater than allowed by Jensen, in that substantial influence can occur under the conditions which generally prevail well above the level of "subthreshold environmental deprivation" regarded by Jensen (1969, p. 60) as constraining intellectual attainment.

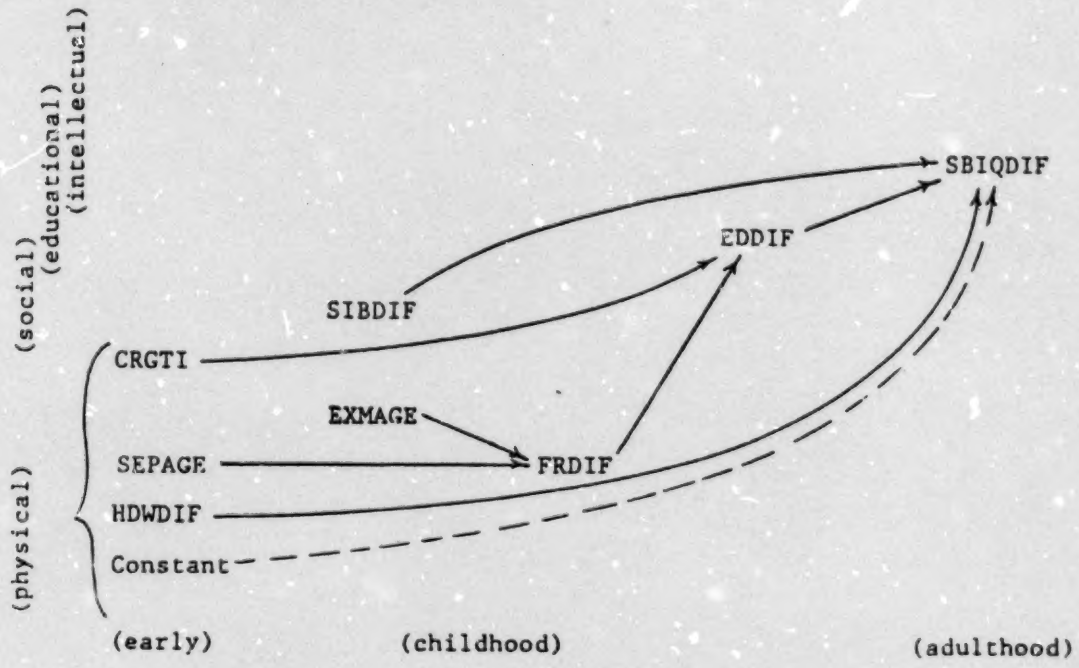
This study reanalyzes the American identical twin data provided by Newman et al.(1937), one of the "only three major studies of MZ twins separated early in life and reared apart" which were used by Jensen (1969, p. 51)

to calculate the percent of variance in individual IQ which is due to genetic variation. The Newman et al. volume provides much more detail regarding environmental conditions than can be obtained from the other two studies, and does not appear to have been compromised by analytical biases of the sort which later were suspected in the English study by Burt (1966).

Analysis here will not follow the convention established by Galton (1883) of correlating inter-twin, inter-relative, and other inter-person IQ levels across pairs of individuals, since even for early-separated identical twins there were common environmental experiences prenatally and in the initial days after birth, so that both genes and environment which are in commor act to yield the high IQ-level correlations which are obtained. Instead, for separated identical twins whose IQs were measured in adulthood, IQ differences are related to the only independent variables which could influence them, to the environmental differences which existed between the twins as children and young adults. Data from which these differences could be calculated were provided in some detail by Newman et al. (1937), and include differences in years of education, in social environment, and in indicators of apparent physical conditions such as nutrition. In this sample of nineteen twin pairs, the average inter-twin Stanford-Binet IQ difference was 8.2 points, which represents slightly more than half of a standard deviation for the entire U.S. population and more than half of the difference which has been found between white and black American means. Thus, the magnitudes of inter-twin differences are not trivial, and environmental explanations of these differences might well be of interest in appraising other situations.

The results of stepwise multiple regression (cf. Franke, 1980) for IQ difference upon all other measured variables explains 78% of the variance in IQ differences--a figure which approaches 100% after correction for attenua-

tion. Furthermore, earlier environmental differences can be used to explain the proximate determinants of IQ differences. The apparent causal network is presented in the figure below:



The model explaining the inter-twin Stanford-Binet IQ differences is:

$$SBIQDF = 5.85 + 1.15\ EDDIF + 7.62\ HDWDIF - 0.93\ SIBDIF,$$

$$t = 6.38 \qquad t = 4.20 \qquad t = -2.40$$

$$(p = .0000) \quad (p = .0008) \quad (p = .0299)$$

$$R^2 = 81.58\%,\ cR^2 = 77.89\%,$$

with the difference in years of education explaining the first 53.65% of the variance, the centimeters difference in head width explaining an additional 20.86%, and the number of siblings in the adopting family an adverse variable explaining a final 7.07%. The data were organized on the basis of Stanford-Binet IQ differences, so that the intercept value of 5.85, which was significant ($t = 6.99$, $p = .0000$) could be held to represent additional environmental differences such as favored position in the womb and higher birth weight,

which were not reported by Newman et al. (1937; cf. Babson & Phillips, 1973; Gärtner & Baunack, 1981). The head width variable is likely to be an indicator of nutritional differences, which at the individual level can influence ability and performance (cf. Franke & Barrett, 1975; Selowsky & Taylor, 1973), while more siblings in the adopting families may reduce the extent of adult-child interaction and thus the child's social stimulation and intellectual development (cf. Breland, 1974; Zajonc, 1983).

In turn, for the proximate determinants of IQ differences, the inter-twin difference in number of years of education was explained (to a total of 57%) by the difference in number of finger ridges (FRDIF), apparently an index of neural sophistication (cf. Penrose, 1970), and (inversely) by physical cross resemblence greater than individual resemblence (of hands; CRGTI), indicating that greater inter-twin physical differences were associated with greater educational differences. The differences in number of finger ridges, which is usually thought to be identical in identical twins, were explained to the extent of 33% by the age of examination as an adult (EXMAGE), and negatively by the age of separation as children (SEPAGE). Apparently, the longer the twins were separated, the greater the differences in finger ridge count became.

In conclusion, the reanalysis of a "classical" set of data, which had been employed to show the genetic determination of intelligence, instead shows substantial determination of intelligence differences (averaging 8 IQ points) by environmental differences. There are many situations for developed nations in which genetic differences seem to be important determinants of individual intelligence differences (cf. Jensen, 1980; Weiss & Mehlhorn, 1982). However, the present analysis suggests that even in advanced societies there are variances in the education, social stimulation, and physical provisions to individuals which substantially determine intelligence.

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